Traveling Science Shows

THE FRANKLIN INSTITUTE

Post-Show

CHEMISTRY

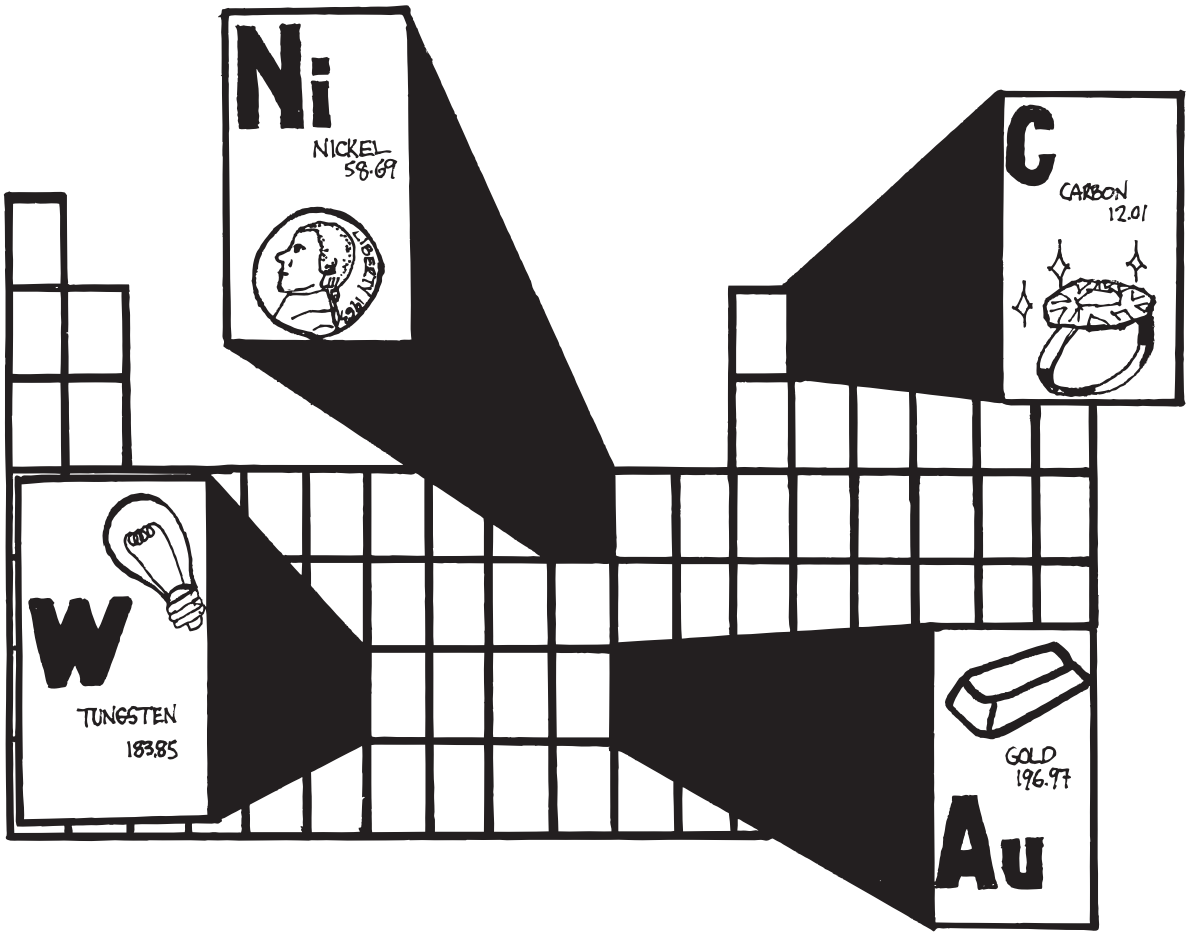
After the Show

We recently presented a Chemistry show at your school, and thought you and your students might like to continue investigating this topic. The following activities are designed to review and extend the ideas covered in the show.

"*To most people, solutions mean finding answers. But to chemists, solutions are things that are still all mixed up.*"
- anonymous 5th grader

Please remember to use appropriate safety measures for all activities. An adult instructor should always supervise students during experiments. Materials in chemistry experiments should never be ingested. Goggles or safety glasses are recommended for all activities, but not required unless stated.

Visit us online at www.fi.edu/TSS or contact us at tss@fi.edu.



FIZZY, BUBBLY FUN

FOR GRADES 1-4

As we learned in the Chemistry show, a chemical reaction occurs when two or more substances form new substances. You can tell when a chemical reaction takes place if it produces heat or light, a color change, or bubbles. Here, students will conduct an experiment to determine how temperature impacts a chemical reaction.

EQUIPMENT

3 clear glass or plastic cups
Hot, cold, and room-temperature water
Seltzer tablets
Stop-watch and thermometer (optional)

PROCEDURE

1. Fill one cup with hot water, another cup with room-temperature water, and the third with ice water.
2. Place a seltzer tablet in each cup and watch the reaction. What signs of a chemical reaction can you observe?
3. In which temperature water did the reaction take place the fastest? The slowest? How can you tell which reaction happened the fastest and slowest? Older students could graph the time it took to complete the reaction against the temperature of the water.
4. Brainstorm other ways to make the reaction happen faster – for instance, breaking the tablet into smaller pieces, or adding vinegar to the water. Now test out your hypotheses!

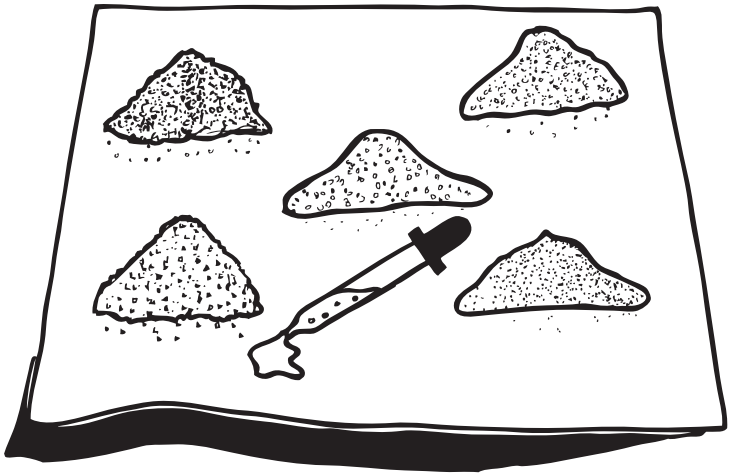
WHY?

Most seltzer tablets are a mixture of two chemicals: sodium bicarbonate (the main ingredient in baking soda) and citric acid. When mixed with water, a chemical reaction produces sodium citrate and carbon dioxide, which bubbles out of the water. In this experiment, students will discover that as temperature increases, the chemical reaction speeds up. This is because heat energy speeds up the molecules, increasing the rate at which they bump into each other and react.

MYSTERY MATTER

FOR GRADES 3-6

Chemists often have to identify unknown materials. During the show, you saw how chemists can use a flame test to identify certain salts. In this experiment, students will observe chemical reactions in order to identify chemicals. Caution students *not to taste* any of the materials.



EQUIPMENT

Small quantities of salt, granulated sugar, baking soda, flour, and cornstarch
Plastic wrap
Small quantities of water, vinegar, and iodine
Eye droppers
Toothpicks
Magnifying glasses

PROCEDURE

Part 1

1. In your small group, collect a small sample of each white powder. Place a small spoonful of each powder in a row on top of a sheet of plastic wrap. Label the powders or note the order on a sheet of paper. Then record some observations of each powder – for instance, the color, shape, and size of the particles.

2. You will conduct tests to observe what happens when each powder is exposed to a different indicator (water, vinegar, and iodine). For the water test, use the eye-dropper to add three drops of water to each sample. Mix with a toothpick. Record your observations in the data table on the next page.

3. Using new samples, Repeat step 2 with each of the other indicators (vinegar and iodine).

Part 2

4. Collect samples of three un-labeled powders. Your task is to identify each powder using your observations of the powder's properties and its reaction with indicators.

5. Present your procedures and conclusions.

6. Dispose of all white powders in the trash. Do not rinse powders down the sink, as they may clog the drain. Wash your hands when finished.

WHY?

Various substances react in characteristic ways with other substances. An indicator is any substance that reacts in a particular way and helps us identify an unknown chemical. In this case, the white powders react differently from one another when mixed with water, iodine, or vinegar. By comparing the reaction of a mystery powder to the known reactions of similar powders, you can draw a conclusion about the mystery powder. Chemists often use indicators and known reactions to identify unknown products of chemical reactions. As a challenge, try to identify a mixture of two different powders during step 4!

MYSTERY MATTER

DATA TABLE

White powder	Observations of its properties	Reaction with water	Reaction with vinegar	Reaction with iodine
Salt				
Sugar				
Baking soda				
Flour				
Cornstarch				
Unknown sample #1				
Unknown sample #2				
Unknown sample #3				

Sample #1 is_____. Our evidence:_____

_____

Sample #2 is_____. Our evidence:_____

_____

Sample #3 is _____. Our evidence:_____

_____

KITCHEN CHEMISTRY

FOR GRADES 5-8

Our Traveling Scientist demonstrated how acids and bases react with each other and with indicators. In this activity, students will use indicator paper to classify common household substances as acids or bases. Before conducting this experiment with students, test out the goldenrod paper; some varieties will work better than others. Students should *avoid skin contact* with the liquids. *Never mix bleach* with other chemicals.

EQUIPMENT

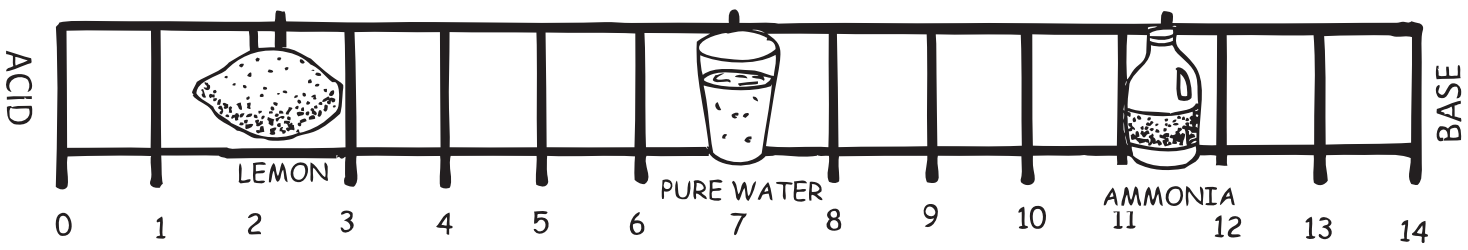
Assortment of liquid bases (such as ammonia, bleach, baking soda and water, milk of magnesia)
Assortment of liquid acids (such as vinegar, lemon juice, orange juice, soda)
Cotton swabs
Goldenrod-colored copy paper

PROCEDURE

1. Create a data table to record how each substance reacts with the paper and whether it is an acid or a base.
2. Obtain a sheet of goldenrod-colored copy paper and a sample of each household substance.
3. Select one of the substances. Predict whether it is an acid or a base. Dip a cotton swab into that substance. Then press the tip of the swab onto the goldenrod paper.
4. What reaction do you observe? Decide whether that substance is an acid or a base, and record your findings in your data table.
5. Test the rest of the substances. Were any of your results surprising?
6. After you have determined which substances are bases, soak a strip of goldenrod paper in a base. Then dip it into one of the acids. What happens? Why?

WHY?

Goldenrod copy paper acts as a pH indicator, meaning that it can be used to determine whether a substance is an acid or a base. Acids and bases react differently to an indicator because of differences in their chemical composition. A base will change the goldenrod paper to red; an acid will not change the color of the paper. An acid can neutralize, or cancel out, a base and return the indicator to its original color.



MORE INFORMATION...

We've provided the following information to help refresh your memory about the topics we covered during the show, and to deepen your understanding about important chemistry topics.

Chemistry: The scientific study of matter, its properties, and interactions with other matter and with energy.

Matter: Any substance that has mass and volume; in other words, all the "stuff" around us. Matter is made up of atoms and molecules. A "chemical" is simply any matter with a definite, known composition. Chemicals are all around us!

Element: A pure chemical substance consisting of only one type of atom. There are 118 known elements, which make up all the matter in the universe.

Periodic Table: An arrangement of the elements by increasing atomic number (the number of protons in an element). The periodic table displays the elements so that one may see trends in their properties and predict how an element will react with another element.

Atom: The basic unit of matter. An atom consists of a nucleus surrounded by electrons. The nucleus is the very dense region at the center of an atom. It consists of protons (which have an electrical charge of +1) and neutrons (which have no electrical charge). Electrons (which have an electrical charge of -1) move very rapidly around the nucleus.

Molecule: An electrically neutral group of at least two atoms held together by strong chemical bonds.

Compound: A group of two or more different elements, held together by strong chemical bonds.

Solid: A state of matter with very tightly packed particles that do not have enough energy to move freely. For this reason, solids have a fixed shape and volume.

Liquid: A state of matter in which particles have enough energy to move freely relative to each other. Liquids have a fixed volume, but not a fixed shape.

Gas: A state of matter in which the molecules have enough energy to spread out and occupy the entire space of the container confining it. A gas has no definite shape or volume.

Physical Reaction: A change where the form of matter is altered, not its chemical substance. Melting ice and evaporating water are examples of physical reactions. In the end, the water is in a different state of matter but it is still water.

Chemical Reaction: A change where ingredients, or reactants, are chemically altered to form new substances, or products. An acid-base reaction and combustion are examples of chemical reactions.

Combustion: A chemical reaction in which a substance combines with oxygen, producing energy in the form of heat and light. Combustion requires fuel, oxygen, and heat.

Substitution Reaction: A type of chemical reaction where an atom, ion, or group of atoms or ions in one reactant molecule is replaced by another atom, ion, or group from another reactant. Also called a "displacement" reaction, it results in two or more new products.

Solution: A blend of two or more liquid substances with a uniform composition throughout. When you dissolve sugar in a glass of water, the ingredients are evenly distributed through the solution.

Mixture: A combination of chemicals in which each substance retains its own chemical identity. That is, the ingredients are not chemically combined. A salad is an example of a mixture – there are no chemical reactions between the tomatoes and the lettuce.

Polymer: A large molecule made up of identical units which are chemically cross-linked. Plastics are petroleum-based polymers.

pH Scale: A number line scale that goes from zero through fourteen. pH is a measure of the concentration of hydrogen ions in a liquid. As we move from zero to fourteen along the scale, the concentration of hydrogen ions decreases.

Acid: Any substance with a pH less than seven. The lower the pH, the stronger the acid. Acids tend to taste sour, and can be corrosive.

Base: Any substance with a pH greater than seven. The higher the pH, the stronger the base. Substances that are basic or "alkaline" taste bitter and often have a slippery feel.

MORE RESOURCES...

Introduction to Matter: Visit http://www.fi.edu/msp/matter/index.html for chemistry activities and resources. You'll find lesson plans, games, videos, and more!

Careers in Science and Technology: Check out http://www.fi.edu/careers/careers_flash.html to meet a chemist, a geologist, a meteorologist, and more fascinating scientists. Follow Ashish through a typical day in the life of a chemist, and then find out what it takes to become a chemist yourself!